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Follow the leader or the pack? Regulatory focus and academic entrepreneurial intentions

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Regulatory focus theory and academic entrepreneurship

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Author biographies

Mark Johnson recently joined the University of the West of Scotland as a lecturer in Accounting and Finance. He is currently studying for a PhD at the Hunter Centre for Entrepreneurship at the University of Strathclyde, with a focus on the behavioural and social aspects of academic entrepreneurship.

Dr Erik Monsen joined University of Vermont's Grossman School of Business in August 2014 as an Associate Professor and Steven Grossman Endowed Chair in Entrepreneurship, and in January 2015 earned a secondary appointment as Associate Professor of Mechanical Engineering in the School of Engineering. He has crossed disciplinary (engineering, management, economics) and geographic (US, Germany, UK) boundaries on his journey from designing aircraft to designing entrepreneurial organizations. Building on personal experiences as aerospace engineer and business consultant in American and European aerospace organizations, his mission is to aid technology and research organizations to be more entrepreneurial and create new value for society.

Dr Niall MacKenzie joined the Hunter Centre for Entrepreneurship, University of Strathclyde, in July 2012. He is Director of Postgraduate Research in the department, and the Principal Investigator on a European Commission funded technology commercialisation project working in conjunction with Fraunhofer and the Swedish University of Agricultural Sciences amongst others. He is a Research Associate of the Centre for Business Research at the University of Cambridge and the Centre for Business History in Scotland at the University of Glasgow and served as Treasurer of the Association of Business Historians in the UK for 3 years until July 2016.

Abstract

Drawing on the academic entrepreneurship and regulatory focus theory literature, and applying a multilevel perspective, this article examines why university academics intend to engage in formal (spin-off or start-up companies and licensing university research) or informal (collaborative research, contract research, continuous professional development and contract consulting) commercialisation activities, and the role local contextual factors, in particular leaders and work group colleagues (peers), play in their commercialisation choices. Based on a survey of 395 science, technology, engineering and mathematics (STEM) academics working in 14 Scottish universities, the research findings suggest that an individual's chronic regulatory focus has a direct effect on their formal and informal commercialisation intent. The results reveal that the stronger an individual's chronic promotion focus the stronger their formal and informal commercialisation intentions and a stronger individual chronic prevention focus leads to weaker intentions to engage in informal commercialisation. In addition, when contextual interaction effects are considered, leaders and workplace colleagues have different influences on commercialisation intent. On the one hand, promotion focused leaders can strengthen and prevention focussed leaders can under certain circumstances weaken a promotion focused academic's formal commercialisation intent. On the other hand, the level of workplace colleague engagement, acting as a reference point, strengthens not only promotion focussed academics' intent to engage in formal commercialisation activities, but also prevention focused academics corresponding informal commercialisation intent. As such, universities should consider the appointment of leaders who are strong role models and have a track record in formal and/or informal commercialisation activities and also consider the importance workplace colleagues have on moderating an academic's intention to engage in different forms of commercialisation activities.

Practitioner Points

1. University policy makers should be aware of how leaders can moderate the commercialisation intentions of their subordinates and in turn shape group norms.
2. Universities who wish to increase levels of academic entrepreneurship should consider the appointment of leaders who are strong role models and have a track record of success in formal and/or informal commercialisation activities.
3. Universities should recognise entrepreneurial colleagues within departments or research groups as commercialisation champions which may further strengthen the influence of peers on academics informal and formal commercialisation intentions.

Introduction

To date, research on commercial outputs from academia has evolved along two distinct streams, each of which focuses on a different mode of commercialisation. The first, which has attracted significant attention, describes formal commercialisation activities (Abreu & Grinevich, 2013) where attempts are made to spin-off or start-up companies and to license university research (Di Gregorio & Shane, 2003; Rothaermel et al., 2007; Van Burg et al., 2008). Although financial returns are highly uncertain, successful exploitation attempts can increase cash flows and the financial stability of a university, department or individual researcher for many years to come.

The second stream of research, informal commercialisation (Abreu & Grinevich, 2013), has been concerned with university-industry linkages where academics participate in contract-based knowledge related exchanges with non-academic organisations, for pre-agreed financial benefit to the institution, research group and individual (Perkmann et al, 2013). These interactions have a long history in academia and include activities such as collaborative research, contract research, continuous professional development and contract consulting (D'Este & Patel, 2007; Perkmann & Walsh, 2008; Hughes & Kitson, 2012; Zhang et al., 2016). Many external organisations recognise these activities as important mechanisms to allow inventions or know-how to be transferred efficiently into their environment (Hughes & Kitson, 2012) and income from informal activities is typically higher than the income derived from attempting to exploit university intellectual property through licensing or spinoffs (Perkmann et al., 2013). Such engagement is often carried out based upon contractual agreements, with relatively swift financial returns on investment. Timescales and resource commitment are pre-determined which in turn may lead to informal

commercialisation activities being perceived as a lower risk option when compared to formal commercialisation activities.

Irrespective of the mode of commercialisation pursued, prior research suggests that academics vary significantly in their motivation to take entrepreneurial action (D'Este & Patel, 2007; Hayter, 2011; Lam, 2011; Perkmann et al., 2013; Roach & Sauermann, 2010). Entrepreneurial action can also be influenced by contextual factors (Roach & Sauermann, 2015) and a small number of researchers have suggested that both academic leaders (e.g. deans, heads of department and research group leaders) and peersⁱ can play an important role in determining why academics engage in commercialisation activities (Nicolaou & Souitaris, 2015; Tartari et al., 2014; Bercovitz & Feldman, 2008; van Burg et al., 2008). To date, few studies have sought to understand how the local context helps shape decision making as to why academics engage in formal or informal activities (Stuart & Ding, 2006; Bercovitz & Feldman, 2008; Hayter, 2011; Libaers & Wang, 2012; Tartari et al., 2014). Therefore, the following research question is posed: which contextual factors encourage or discourage academics to engage in more or less uncertain entrepreneurial activities?

In order to answer this question, this article draws on regulatory focus theory (Higgins, 1997 & 1998) to explain the motivational factors that promote and/or hinder an academic's entrepreneurial intent. Regulatory focus theory defines two self-regulatory systems, known as promotion focus and prevention focus that influence individuals' behaviour and choices. Regulatory focus theory posits that individuals adopt either a prevention focus (a focus on the costs and perceived benefits of avoiding failure) or a promotion focus (a focus on the perceived benefits and costs of not achieving success) (Higgins, 1997 & 1998). At any time, both self-regulatory systems exist, but one system will dominate the other, due to either situational triggers (Crowe & Higgins, 1997) or an individual's chronic predisposition (an established personality trait) when situational triggers are lacking (Higgins, 1998).

The insights gleaned from this empirical investigation, involving a survey of 395 academics working in STEM disciplines across 14 Scottish universities, revealed the following contributions to the literature. First, this work contributes to greater understanding of academic entrepreneurship and how actors working in their local context can moderate, at a cognitive level, academics' commercialisation intentions. Second, at the theoretical level, this study offers a new perspective in the academic entrepreneurship and regulatory focus literature by demonstrating how academic leaders directly (through role modelling effects) and indirectly (through the level of colleague engagement within their group) affect an academic's commercialisation intentions. Third, the findings also confirm that chronic prevention focused individuals are capable of engaging in academic entrepreneurship, and thus it is methodologically important that both promotion and prevention focused scale items should be used in future studies of the field to help bring greater understanding of the motivations as to why academics behave the way they do. Fourth, the findings support proposals from other scholars (e.g. Davidsson & Wiklund, 2001), that more multi-level research is required to better understand different forms of entrepreneurship. Finally, this study provides an innovative theoretical and empirical model for how future researchers can study multilevel interactions between the individual, their leaders and colleagues in university contexts, and in turn better explain how actors in these contexts interact to enhance or diminish an academics motivation and commercialisation intent.

The article proceeds as follows. The background literature on academic entrepreneurship, risk and uncertainty and the nature of formal and informal commercialisation activities is introduced. Next, regulatory focus theory is used to develop hypotheses predicting the intent of academics to engage in formal or informal commercialisation activities. Details of the methods used and the data analysis process follows, and finally, a discussion of the findings is presented which is followed with conclusions for academics and practice.

Academic Entrepreneurship, Risk and Uncertainty

The term ‘academic entrepreneurship’ has recently been redefined to encompass the two streams discussed above as “any activity that occurs beyond the traditional academic roles of teaching and/or research, is innovative, carries an element of risk, and leads to financial rewards for the individual academic or his/her institution” (Abreu & Grinevich, 2013, p. 408). These can be categorised as two competing ends within a risk-reward spectrum. Formal commercial activities where timescales and financial returns are highly uncertain sit at one end of the spectrum, and informal commercial activities that offer pre-agreed financial returns at the other.

Both types of commercialisation activities have the potential to bridge funding gaps, meaning academics are competing in the market place to maximise revenues from engaging in entrepreneurial activities. Informal commercial entrepreneurial activities undertaken via assisting non-academic organisations with either the implementation of, or improvement to products, process or services are considered to be more aligned with long standing traditional academic outputs (Klofsten & Jones-Evans, 2000; Philpott et al., 2011). While these activities still carry an element of risk (particularly reputational risk), pre-contractual agreements can be put in place which clearly outline the financial return to the academics and/or their institution. The skills required are typically familiar, with expected time frames and the income to be received agreed before the project commences, so any level of uncertainty is substantially reduced. Formal commercial activities are more entrepreneurial in nature with investments in time and financial returns highly uncertain, and the skills required to be successful are often unfamiliar to many academics (Hughes & Kitson, 2012; Klofsten & Jones-Evans, 2000; Philpott et al., 2011). The differences between informal activities, with more certain outcomes, and formal activities where outcomes are inherently uncertain, are presented in the following spectrum of academic entrepreneurial activities.

Figure 1: Academic Entrepreneurship Spectrum

Insert figure 1 around here.

In the context of the spectrum above, various forms and levels of uncertainty exist. This suggests that engaging in entrepreneurial action requires the decision maker to exercise judgment as to which activities are likely to be most valued and be rewarded, as the rules of the game and potential outcomes may be unclear. As a result, prior research has found that academics vary significantly in their motivation to take entrepreneurial action (D'Este & Patel, 2007; Hayter, 2011; Lam, 2011; Perkmann et al., 2013) and two key reasons can be found in the wider literature.

Firstly, participating in the activities outlined above often requires a skill-set that may be viewed as contradictory with the skills required to undertake core activities such as teaching, grant writing and publishing journal articles (D'Este & Patel, 2007). Academics often have to allocate a significant amount of attention towards excelling in these core activities if they are to achieve recognition and promotion, thus reducing their motivation to engage in commercialisation activities. Secondly, it may not be immediately obvious which commercialisation activities they should focus their attention on. Researchers have suggested that the local context (i.e. the behaviour of others) may impact where and how individuals focus their attention (Bercovitz & Feldman, 2008; Stuart & Ding, 2006; Tartari et al., 2014). Observing their local contextual conditions can make it easier for academics to understand what activities are valued and expected within their group (Markides, 2007), providing guidance as to where they should focus their attention. As a result, this should allow an academic to estimate the value of engaging in commercialisation activities in relation to others working in their local context, typically their leader and/or work-group colleagues.

Understanding how these interactions between the individual academic and their leader and/or work colleagues affect an individual's commercialisation intent still remains less well-

understood (Bercovitz & Feldman, 2008; Tartari et al, 2014). In order to account for any potential motivational differences, regulatory focus theory is introduced, to explain why some academics display greater motivation to engage in commercialisation activities and how leaders and/or colleagues can stimulate as well as hinder an academic's formal or informal commercialisation intent.

Regulatory Focus Theory

Regulatory focus theory (Higgins, 1997) suggests that decision making and behaviour is largely determined by how individuals allocate their attention (Higgins, 1997; McMullen & Zahra, 2009) and that there are two chronic systems that individuals use to regulate their behaviour, these being promotion or prevention focus (Higgins, 1997). As an individual's chronic regulatory focus is an established personality trait (Higgins, 1997), regulatory focus theory helps explain why some individuals have more confidence in achieving goals than others and why individuals set different goals or adopt differing strategies to achieve their goals (Higgins, 1997 & 1998).

When experiencing promotion focus, an individual's attention is primarily allocated towards maximal goals (Higgins et al., 2001) such as maximising the return, in risk-return decisions (McMullen et al., 2009). In order to fulfil nurturance needs, promotion focused individuals attempt to bring themselves into alignment with their 'ideal' selves (Higgins, 1997). As a result, they are more sensitive to the presence or non-presence of positive outcomes and are attracted towards the pursuit of approach-oriented ends, such as success or gains. Individuals experiencing promotion focus therefore adopt strategies of goal pursuit which foster desired outcomes (Crowe & Higgins, 1997), remember information relevant to success (Higgins & Friedman, 2001), are concerned with advancement, growth and achievement and are sensitive to emotions such as happiness and dejection (Brockner & Higgins, 2001). Promotion focus can be considered as "a disproportionate allocation of

attention to the benefits that are expected if one chooses to act and is successful in that endeavor” (Wu et al., 2008, p. 589).

When experiencing prevention focus, an individual’s attention is primarily allocated towards minimal goals (Higgins & Friedman., 2001) such as minimising the risk, in risk-return decisions (McMullen et al., 2009). In order to fulfil motivational needs relating to responsibility, security and safety, prevention-focused individuals attempt to bring themselves into alignment with their ‘ought’ selves (Higgins, 1997). As a result, they are more sensitive towards negative outcomes and attempt to avoid failure or losses. Individuals experiencing prevention focus recall and notice information related to the avoidance of failure, are concerned with security, safety and responsibility and are sensitive towards emotions such as quiescence and anxiety. Thus, they adopt strategies of goal pursuit aimed towards preventing negative outcomes (Förster et al., 1998; Förster, Higgins, & Bianco, 2003; Higgins & Friedman., 2001). Prevention focus can be considered as “a disproportionate allocation of attention to the costs that are expected to be incurred if one chooses to act and is unsuccessful in that endeavor” (Wu et al. 2008, p. 590).

Regulatory Focus Theory and Entrepreneurship

It has been suggested in the wider entrepreneurship literature, that certain individual factors distinguish those who act more entrepreneurially. For example, individuals experiencing a promotion focus are more creative, willing to consider new ideas and to ‘think outside the box’ compared with those experiencing a prevention focus (Friedman & Förster, 2001). An interest in ‘gains’ even when the probability of success may be low (Higgins, 2000), indicates that individuals with a promotion focus may be more open to entrepreneurial activities where the outcomes are uncertain (Hmieleski & Baron, 2008).

Prodan & Drnovsek (2010) examined academics intentions to spin out a technology and found that entrepreneurial self-efficacy was the key predictor of entrepreneurial intent,

implying that those academics with high self-efficacy should be more likely to consider entrepreneurial action. Tumasjan & Braun (2011) empirically tested the relationship between regulatory focus theory and self-efficacy, and found a significant relationship between promotion focus and opportunity recognition, while prevention focus was not found to be significantly related to opportunity recognition. McMullen and Shepherd (2002) examined the effects of regulatory focus on individuals and found that as the perceived benefits of taking entrepreneurial action increased, so too did their entrepreneurial intent, which was stronger for individuals in a promotion focus than those in a prevention focus. Foo et al., (2011) investigated the effects of promotion focus on the entrepreneurial intent of Norwegian scientists, finding that promotion focus did not by itself predict entrepreneurial intentions but that both individual and environmental factors, not either factor alone, predicted entrepreneurial action.

In line with the literature findings outlined above, it can be suggested that promotion focused academics are more likely to display greater creativity than their prevention focused colleagues (Brockner, Higgins, & Low, 2004). Greater creativity should lead to more disruptive inventions and/or innovative research outputs, thus increasing the likelihood of identifying commercialisation opportunities. Promotion focused academics should also be more willing to bear the uncertainty and risk (Sitkin & Pablo, 1992) involved in engaging in commercialisation activities as well as believing more strongly that they have or can acquire the skills to successfully engage in these activities (Prodan & Drnovsek, 2010). The result of which should lead to an increase in entrepreneurial intent when compared to prevention focused colleagues (McMullen & Shepherd 2002), which leads to the following hypotheses:

Hypothesis 1a: *The stronger an academic's chronic promotion focus, the stronger their intention to engage in formal commercial activities.*

Hypothesis 1b: *The stronger an academic's chronic prevention focus, the weaker their intention to engage in formal commercial activities.*

Hypothesis 2a: *The stronger an academic's chronic promotion focus, the stronger their intention to engage in informal commercial activities.*

Hypothesis 2b: *The stronger an academic's chronic prevention focus, the weaker their intention to engage in informal commercial activities.*

Situational Regulatory Focus

In order to develop the interaction hypotheses regarding leaders and colleagues, it is important to explain the difference between situational and chronic regulatory focus as both influence an individual's preference for action (Förster et al., 2003). An individual's chronic regulatory focus is an established personality trait (Higgins, 1997) and when strong situational cues are lacking, an individual's chronic regulatory focus will dominate (Wu et al., 2008). However, situational cues (e.g. leaders and colleagues) where the possibility of gains or losses exist, may lead to an individual eliciting an alternative regulatory focus (Keller & Bless, 2006).

This has been demonstrated in studies where manipulation has been used to elicit a certain regulatory focus. Researchers have found that when an individual is exposed to certain stimuli (i.e. they are primed), this can manipulate their regulatory focus. When primed to be concerned with ideal attainment and maximising gains then a promotion focus is exhibited, when primed to be concerned with duty, safety and minimising loss, then a prevention focus is elicited (Förster et al., 1998). In turn, this affects how individuals sub-consciously pursue goals and can also change how individuals behave over longer time periods (Kirk & McSherry, 2012). In developing the following interaction hypotheses, the concept of situational factors is applied, firstly to the context of leaders and secondly to the context of colleagues.

Regulatory Focus and Leader Role Modelling

Contradictory demands within academia create doubts for academics, making it difficult for clear priorities to be set to guide behaviour (Ambos et al., 2008). Consequently, leaders play an important role in framing the situational context and achieving organisational or group outcomes. The behaviours they adopt can lead to differing outcomes towards entrepreneurial thinking, risk taking and innovation (Avolio et al., 1999; Bass & Avolio, 1994). Prior research undertaken by Bercovitz and Feldman (2008) discovered that academic leaders and their entrepreneurial actions have the potential to influence faculty through role modelling.

Within the academic entrepreneurial process, the manner in which group leaders interact with their subordinates provides an important situational cue in the priming of self-concepts (Lockwood et al., 2002). The behaviour and actions of academic leaders assists in the creation of situational group norms by signalling to academics what entrepreneurial actions are valued and expected (Jain et al., 2009). Specifically, academic leaders can direct an academic's attention towards or away from formal and informal commercialisation activities by projecting their vision and the subsequent benefits for both parties. Brockner & Higgins (2001) suggest that leaders and their differing behaviours will evoke different levels of situational promotion or prevention focus in their subordinates, which in turn should affect their motivation to engage in formal and informal commercialisation activities.

When applying regulatory focus theory as a lens, it can be understood that chronic and situational regulatory foci can interact to affect an individual's behaviour (Brockner & Higgins, 2001; Shah, Higgins, & Friedman, 1998). Kark & Van Dijk (2007) suggest that a leader's regulatory focus should interact with an individual's chronic regulatory focus and when there is congruence between situation and chronic promotion foci, motivation to take entrepreneurial action should be increased. When incongruence occurs, the moderating effect

of situational and chronic regulatory foci is likely to weaken an individual's motivation to take entrepreneurial action (Van-Dijk & Kluger, 2004). Thus, via role-modelling, academic leaders should moderate an academic's behaviour, regardless of their chronic regulatory focus (Kark & Van Dijk, 2007). An academic leader whose behaviour is perceived as being highly promotion focused, is likely to interact with their subordinate's chronic regulatory focus to produce increased motivation in their subordinates thereby increasing their formal or informal commercialisation intent. In contrast, a leader whose behaviour is perceived as highly prevention focused is likely to interact with their subordinate's chronic regulatory focus reducing their motivation and thereby lowering their intent making them less likely to engage in formal or informal commercialisation activities. Therefore, the following interaction hypotheses are offered:

Hypothesis 3a: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic regulatory focus and their intention to engage in formal commercial activities.*

Hypothesis 3b: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic regulatory focus and their intention to engage in formal commercial activities.*

Hypothesis 4a: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic regulatory focus and their intention to engage in informal commercial activities.*

Hypothesis 4b: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic regulatory focus and their intention to engage in informal commercial activities.*

Regulatory Focus and Colleague Engagement

The more general environment academics work in, can also provide situational cues. Some researchers have found that academics are also motivated to engage in commercialisation activities through being exposed to the group norms (Bercovitz & Feldman, 2011,) and by peers working within their local environment (Tartari et al., 2014). If an academic's colleagues value patents and awards, then that academic is more likely to participate, whilst the opposite is true if colleagues value traditional academic activities (Haeussler & Colyvas, 2011). Higgins (1997) discusses a further self-regulatory principal, which is that individuals can also use salient reference points in order to guide their behaviour. This is referred to in the cognitive psychology literature as regulatory reference (Carver & Scheier 1998; Higgins, 1997) and is independent of, but complementary to regulatory focus. As such, if individuals view a particular reference point as having positive value, this will correspond to them experiencing attraction toward it. Experiencing something as having negative value will correspond to them experiencing repulsion from it (Higgins, 1997). Higgins (1997) proposed that regulatory reference research remained incomplete and suggested that regulatory focus theory be used in combination with the reference point to explain why individuals adopt different strategies.

As group norms are also considered to be a motivating factor in academics commercialising their research (Haeussler & Colyvas, 2011; Hayter, 2011; Louis et al., 1989), this implies that the level of formal and informal commercialisation activities (two key reference points) of colleagues within their work group may also affect the intensity of promotion or prevention focus an academic will experience (Higgins, 1997) in turn affecting their commercialisation intent.

In groups where the level of colleague formal and informal commercialisation engagement is high, this reference point, in combination with an individual's chronic promotion focus should lead to academics viewing formal and informal commercialisation activities as

‘desired end states’. In terms of formal commercialisation activities, the reverse should be true for prevention focused academics. As they will be motivated to avoid failure or losses engaging in formal commercialisation activities will be viewed as undesirable and will result in a lower intent to engage. Informal commercialisation activities can be perceived as a lower risk commercialisation option and as something academics perhaps ‘ought’ to be doing, (Higgins, 1998). As a result, in groups where the level of colleague informal commercialisation engagement is high, this reference point will moderate a chronic prevention focused individual’s behaviour. As prevention focused individuals have values aligned with security and responsibility, they should in turn be motivated to match the level of informal commercialisation activity of their colleagues, in order to maintain their “group membership”. Therefore, the following interaction hypotheses are offered:

Hypothesis 5a: *The greater the level of colleague engagement in formal commercialisation activities, the more positive the relationship between the individual’s chronic promotion focus and their intention to engage in formal commercialisation activities.*

Hypothesis 5b: *The greater the level of colleague engagement in formal commercialisation activities, the more negative the relationship between the individual’s chronic prevention focus and their intention to engage in formal commercialisation activities.*

Hypothesis 6a: *The greater the level of colleague engagement in informal commercialisation activities, the more positive the relationship between the individual’s chronic promotion focus and their intention to engage in informal commercialisation activities.*

Hypothesis 6b: *The greater the level of colleague engagement in informal commercialisation activities, the more positive the relationship between the individual’s chronic prevention focus and their intention to engage in informal commercialisation activities.*

Taken as a whole, Figure 2 summarises the conceptual model, which outlines individual, leader and colleague interactions on an academic's formal and informal commercialisation intentions.

Figure 2: Proposed model of relationships amongst key constructs in the study

Insert Figure 2 here

Methods

Previous studies have suggested that formal commercialisation activities tend to be concentrated amongst the top-ranked universities while informal commercial activities are more prevalent in less research intensive universities (D'Este & Patel, 2007; Di Gregorio & Shane, 2003; Ponomariov, 2007). However, more recent studies (Hughes & Kitson, 2012; Markman et al., 2008) have shown that both formal and informal commercialisation activities are becoming part of the everyday activities of all universities (Perkmann et al., 2013). Consequently, the sample includes two universities that are research intensive and the remaining universities are less research intensive. All universities in the study have dedicated units to assist in supporting commercialisation activities.

Sample

The sample comprised 395 academics across 14 Scottish universities with respondents working in the STEM disciplines of physics and astronomy (13%), chemistry (11%), mathematics and computing (17%), engineering (19%), material science (2%), biological sciences (34%) and veterinary and agricultural sciences (4%). Academic discipline is an important variable when considering academic entrepreneurship, as opportunities to engage in differing academic entrepreneurship channels vary across academic disciplines (Wright et al, 2004; Hughes & Kitson, 2012). Laukkanen (2003) identified that opportunities to behave entrepreneurially in STEM related disciplines are higher when compared to other disciplines.

Survey

An on-line questionnaire was e-mailed (in three waves) to 7065 academics in 14 Scottish universities which encompassed all academic disciplines in 2014, following a successful pilot. The software used to deliver the survey allowed for responses to be tracked and reminder messages were sent out twice to those who did not respond initially. The multidisciplinary survey yielded 818 useable responses, giving an 11.6% response rate, with 395 responses falling into the STEM disciplines. It should be noted that some non-response bias was evident in the survey. A test for non-response bias was carried out on all the test variables, t-tests indicated no significant differences between waves 1 & 2, and waves 2 & 3; there were however two control variables with significant differences between waves 1 & 3. Those individuals who work in research intensive universities ($t = -2.798, p < .01$), and individuals who have a basic research focus ($t = 2.229, p < .05$), were more inclined to respond to the later wave. As individuals who respond to later waves are assumed to have done so because of increased stimulus, their responses are expected to be most comparable to non-respondents (Armstrong & Overton, 1977).

Measures

In the following section the descriptions for measuring the dependent, independent and control variables analysed in the survey are provided. Sources, sample items, and measures of statistical validity are in the Appendix.

Dependent variables

Prior research shows that strongly held intentions are correlated with subsequent entrepreneurial behaviour (Krueger et al, 2000). In this study an academic's entrepreneurial intention is defined as an individual's intent to engage in formal and informal commercial activities. Following Douglas & Fitzsimmons (2012) respondents were asked how likely it was that they would engage in formal and informal commercialisation activities within the next 2 years and created two distinct dependent variables, depending on whether their

intention was towards formal or informal commercialisation activities. Formal commercialisation intentions were measured by asking respondents to rate their intent as to the likelihood they would start a company based on their research or license their research to a third party. The two items were measured on a 7-point scale ranging from very unlikely (1) to very likely (7) and then averaged to derive a single score. Informal commercialisation intentions were measured by asking respondents to rate their intent for each of the four informal activities selected on a 7-point scale, ranging from very unlikely (1) to very likely (7). The four informal commercialisation activities (continuous professional development, collaborative research, contract research and contract consultancy) were chosen as they consistently bring in significant revenues to universities (Perkmann et al., 2013). The intent to take entrepreneurial action for each of activities was averaged to derive a single score.

Independent variables

An academic's chronic regulatory focus was measured using Lockwood, Jordan, and Kunda's (2002) 18-item general regulatory focus scale. Respondents were asked to indicate their answer on a 7-point scale which ranged from strongly disagree (1) to strongly agree (7). This assesses one's promotion and prevention focus over nine items respectively. Leader regulatory focus aims to reflect an academics assessment of their leaders' regulatory focus, and was measured with the 7-item leader regulatory focus measure developed by Wu et al (2008). Again, respondents were asked to indicate their answer on a 7-point scale which ranged from strongly disagree (1) to strongly agree (7). The level of formal and informal colleague engagement within one's group was measured using two single item 5 point Likert scales which ranged from nobody (1) to everybody (5) to reflect the level of colleague engagement for each of the dependent variables.

Control Variables

Prior research has found that certain factors play an important role in predicting differing types of academic entrepreneurship (Abreu & Grinevich, 2013; D'Este & Patel, 2007; Perkmann et al., 2013). We thus identified and controlled for nine individual, job-related, and organisational factors (italicized) that influence academic intent and behaviors.

Individual factors: *Gender* was coded as Female (0) Male (1), 71.9% of the respondents were male. For *age*, five categories were used: <under 30 years (3% of respondents), 30-39 (31.6%), 40-49 (28.6%), 50-59 (26.3%) and 60 and over (10.4%). *Prior entrepreneurial experience* was assessed by asking participants whether or not they had prior entrepreneurial experience through starting their own company; variables were coded no (0); yes (1); 14.7% of respondents claimed to have started a company in the past. **Job-related factors:** *Academic Rank*: seniority was measured and coded using the following four academic ranks; Professor = 4 (26.3%), Senior lecturer/Reader (Associate Prof) (27.8%), Lecturer (Assistant Prof) (23.8%), Research/Teaching fellow/associate = 1 (22.0%). *Employment status* was coded as Fixed contract (0); Tenured (1), 74.2% of the sample proved to be tenured academics. *Applied vs Basic research* variables were coded as basic research (0) applied (1); 47.1% of the respondents indicated their research was applied. *Management responsibility* variables were coded as no (0); yes (1); a high percentage of the respondents (59.2%) stated that they had management responsibility within their institutions. **Organisational factors:** *Research intensive university* was coded as (1), non-research intensive as (0); 38.2% of respondents were from the former type. For *resources for innovation* Scott and Bruce's (1994) 6 item measure was used to assess the degree to which respondents believed that university resources were used to encouraged innovative behaviour. Respondents were asked to indicate their answer on a 7-point scale which ranged from strongly disagree (1) to strongly agree (7).

Interaction variables

Interacting variables were generated by multiplying the leader regulatory focus or the level of formal or informal colleague engagement variables with the individual chronic promotion and prevention focus variables, respectively (Cohen et al., 2003).

Results

Descriptive statistics and a correlation analysis can be found in Table 1. These results provide a preliminary insight into the relationship between promotion focus and prevention focus in relation to an academic's commercialisation intentions.

Insert table 1 about here.

Hypotheses testing

To test the main effect and interaction hypotheses set out above, firstly a hierarchical OLS regression analysis was conducted (Cohen et al., 2003) which included all the control variables and the individual variables (i.e. promotion and prevention focus) as set out in table 1. Secondly, as some authors have expressed concerns that interactions may remain undetected during regression analysis due to lack of statistical significance (Aguinis, 1995; Saemundsson & Candi, 2014), simple slope analysis was conducted on all the interaction variables within the models in order to check the nature of the interactions (Aiken & West, 1991). The output models relating to the two dependent variables are presented in the tables 2 and 3. Table 2 presents formal commercialisation intentions (Models 1 to 8), and Table 3 presents informal commercialisation intentions (Models 9 to 16).

Insert table 2 about here

Insert table 3 about here

The results of the hypotheses set out above and the respective R^2 increase are summarised in table 4. In the following section the significant findings are summarised.

Insert table 4 about here

Turning to chronic promotion and prevention focus and an individual's commercialisation intentions. As shown in Table 2, Model 2 a significant positive relationship was found between an individual's chronic promotion focus and an academics intention to engage in formal commercialisation activities (Hypothesis 1a). In Table 3, Model 10 again a significant and positive relationship was found between an individual's chronic promotion focus and their informal commercialisation intentions (Hypothesis 2a). Meanwhile, a significant and negative relationship between an individual's chronic prevention focus and their informal commercialisation intentions as hypothesised (Hypothesis 2b).

In order to analyse the interaction hypotheses the regression procedures recommended by Cohen et al. (2003) were followed. The independent variables were examined for variance inflation factors (see appendix for VIF results) with none of the interaction variables recording a value of greater than 1.36, well below the conservative threshold of 5. It is highly unlikely that multicollinearity was present amongst the independent variables. Simple slope analysis was also conducted to illustrate the significant interactions between leaders and colleagues on an academic's formal or informal commercialisation intentions (see Figs. 3 through 6). The significant interactions were graphed at + (high) and - (low) one standard deviation from the mean and the gradient of the slopes was calculated in order to understand the range of values the relationships remain significant.

Hypothesis 3a through 4b tested the interaction between the leader's regulatory focus and the individual's chronic regulatory focus to understand if this moderated an academic's commercialisation intentions. A positive relationship between leader promotion focus, the individual's chronic regulatory focus and their intention to engage in formal commercialisation activities (Table 2, Model 4) was found as set out in Hypothesis 3a. Additionally, a significant and positive interaction was also found between Individual chronic promotion focus x Leader promotion focus and formal commercialisation intentions (Figure

3) which on its own explained $R^2=.013$ ($p<0.01$) of Model 4's increase over and above the main effects (Model 3).

Whilst a negative relationship between leader prevention focus, the individual's chronic regulatory focus and their intention to engage in formal commercialisation activities (Table 2, Model 5) was found, neither the model ($R^2 = .01$; $p=.08$) nor the interaction variables (Individual chronic promotion focus x Leader prevention focus $p=.07$ and Individual chronic prevention focus x Leader prevention focus $p=.17$) were statistically significant, so Hypothesis 3b is not supported. However, as researchers (e.g. Aguinis, 1995; Saemundsson & Candi, 2014) have found interactions can remain undetected during regression analysis, simple slope analysis was conducted on both the interaction variables as a further check. The Individual chronic promotion focus x Leader prevention focus variable which explained $R^2=.006$ of Model 5's increase over the main effects (Model 3) demonstrates that a moderating effect is actually present (Figure 4), which has a negative effect on the formal commercialisation intentions of individuals high in chronic promotion focus.

Figure 3: Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Promotion Focus on Formal Commercialisation Intentions

Insert Figure 3 About Here

Figure 4: Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Prevention Focus on Formal Commercialisation Intentions

Insert Figure 4 About Here

Hypotheses 5a through 6b sought to understand if an academic's intention to engage in commercialisation activities is moderated by the level of colleague formal or informal commercialisation engagement in their work group. It is clear that the Level of formal colleague engagement x Individual chronic promotion focus interaction (Table 2, Model 7) is positive and significant in predicting an academic's formal commercialisation intentions

finding support for Hypothesis 5a, and is illustrated in Figure 5. Finally, a significant and positive relationship between the Level of informal colleague engagement x Individual chronic prevention focus interaction (Table 3, Model 15) was found which moderates chronic prevention focused academics' informal commercialisation intentions finding support for Hypothesis 6b, and is illustrated in Figure 6.

Figure 5: Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Level of Formal Colleague Engagement on Formal Commercialisation Intentions

Insert Figure 5 About Here

Figure 6: Interaction Diagram Showing the Interaction between Individual Chronic Prevention Focus and Level of Informal Colleague Engagement on Informal Commercialisation Intentions

Insert Figure 6 About Here

Discussion and Conclusion

The purpose of this research was to investigate the local contextual factors that, at the cognitive level, encourage or discourage academics to engage in more or less uncertain entrepreneurial activities. Given that academia is a resource constrained environment (Gulbrandsen & Smeby, 2005), academics are increasingly likely to consider taking entrepreneurial action to increase revenues from formal and informal commercialisation activities in order to help mitigate traditional funding reductions. Drawing upon regulatory focus theory and adopting a multi-level perspective a research model was proposed and tested which suggested that independent to an individual academic's chronic regulatory focus, their leader's and colleagues' behaviour can enhance or diminish an academic's intention to engage in a range of formal or informal commercialisation activities. Overall, the findings support several of the hypotheses set out in the research model (Figure 2).

Prior research has indicated that both formal and informal commercialisation tended to be individually driven and pursued on a discretionary basis (Perkmann et al., 2013). When

viewed in isolation, the findings show that the stronger an academic's chronic promotion focus, the more likely they are to view academic entrepreneurship as a gain scenario (Higgins, 1998). They will attempt to maximise the return in risk-return decisions and in line with McMullen and Shepherd (2002), the findings display strong intentions to engage in commercialisation activities. Conversely, the analysis also found that the stronger an academic's chronic prevention focus, the more likely they are to view academic entrepreneurship as a loss scenario (McMullen & Shepherd, 2002). They will seek to minimise the return in risk-return decisions, resulting in a weaker intent to engage in informal commercialisation activities.

A key aspect of regulatory focus theory is that an individual's chronic and situational regulatory foci can interact to affect their behaviour (Brockner & Higgins, 2001; Shah et al., 1998). As academics typically do not work in isolation, these findings can have implications for commercialisation outputs. The local context is clearly an important element in the entrepreneurial process and commercialisation choices (Roach & Sauermann, 2015). Our findings, particularly in relation to the choice of moderators (leaders and colleagues) within the study, find some support for Foo et al.'s (2011) study, where they concluded that promotion focus alone is not enough to predict entrepreneurial intent and that other contextual factors need to be taken into account to fully understand entrepreneurial intent within academia.

When contextual-level factors are taken into account, the academic leaders' regulatory focus can interact with an individual's chronic regulatory focus to affect the direction and intensity of their commercialisation intent. Previous research (Bercovitz & Feldman, 2008) found that the entrepreneurial activities of the departmental chair had the potential to influence subordinates. The results of this study move this debate forward and show that all academic leaders have the potential to shape the level and type of commercialisation

subordinates undertake within their respective universities, departments or groups.

Interactions between a leader's regulatory focus and the individual's chronic regulatory focus can influence entrepreneurial behaviours, in general the findings show that interactions between the leader's promotion focus and the individual's chronic regulatory focus leads to positive intent regardless of their chronic regulatory focus for both formal and informal commercialisation activities.

The regression results and simple slope analysis (Figure 3) demonstrates that this interaction is particularly strong when there is congruence (e.g. high leader promotion x high individual chronic promotion) particularly when commercialisation outcomes are uncertain. Lockwood, Jordan, and Kunda (2002) found congruency effects when they demonstrated that individuals are increasingly motivated by role models who encourage strategies that fit their chronic regulatory focus. This suggests that promotion-focused academics are inspired by leaders who are positive role models and who highlight strategies for achieving success when outcomes are uncertain (Bercovitz & Feldman, 2008).

While there was no statistical support for Hypothesis 3b, we did find through simple slope tests (Figure 4) that interactions between prevention focused leaders and individuals with a chronic promotion focus exist which lead to weakened formal commercialisation intentions in the latter. As individuals high in chronic promotion focus are more likely to engage in formal commercialisation activities (Hypothesis 1a), this potentially has important implications for entrepreneurial universities. In particular, when such incongruence occurs between situational and individual regulatory states (e.g. high individual chronic promotion focus x high leader prevention focus), this has been found to destabilise an individual's behaviour (Camacho, Higgins, & Luger, 2003; Lisjak, Molden, & Lee, 2012). As a result, if the behaviour and actions of an academic leader is signalling to academics working in their group that engagement in formal commercialisation activities is not valued or expected, over

time this may result in a loss of entrepreneurial motivation. This resulting loss of entrepreneurial motivation could eventually lead to either complete inactivity or dissatisfaction, as academics high in chronic promotion focus are not being motivated to fulfil their 'ideal' selves when considering commercialisation choices.

The next significant contextual-level factor in the model was the level of colleague engagement in formal and informal activities in an academic's work group and the role the group norm plays in the entrepreneurial process, as an important reference point. The findings show that the level of formal or informal colleague engagement by peers in their work group also acts as an important motivational factor (Tartari et al., 2014; Hayter, 2011) and their motivation to engage in commercialisation activities can be influenced by the behaviour of colleagues. Our results found support for the interaction between the level of colleague formal engagement and an individual's chronic promotion focus. This may be explained by the fact that individuals high in promotion focus will see formal commercialisation activities as a desired end state and their motivation is strengthened by observing other colleagues participating, highlighting the importance of maintaining favourable formal commercialisation norms (Van Berg et al., 2008; Nicolaou & Souitaris, 2015).

Finally, a significant interaction was found between the level of informal colleague engagement and prevention focused individuals. This result may seem surprising given that when viewed in isolation individuals who are high in chronic prevention focus display significant negative intentions (Table 3, Model 10) to engage in informal commercialisation activities. However, as chronic prevention focused individuals have values aligned with security and responsibilities, they will be more sensitive to changes in the social or group norms (Lam, 2011). High levels of colleague engagement can intensify the value of group membership and the findings indicate that the level of informal colleague engagement and the

individual chronic prevention focus interaction, leads to a slightly positive but sustained intention to engage in informal commercialisation activities. The study also revealed, that as the level of colleague engagement decreases (Figure 6) the intent of individuals high in chronic prevention decreases. In both cases these outcomes suggest that chronic prevention focused academics react to the level of colleague commercialisation engagement in their groups, motivating them to match the commercialisation level of other colleagues in order to maintain group membership or norms.

These findings led to a further question; does a leader's regulatory focus determine the level of colleague commercialisation engagement within their group? In order to determine this a regression analysis (including all control and leader promotion and prevention focus variables) was conducted, with the level of colleague formal and informal commercialisation engagement as the dependent variables. The results confirmed that promotion focused leaders had increased levels of colleague engagement for both formal ($\beta = 0.17$, $p < 0.001$) and informal commercialisation ($\beta = 0.12$, $p < 0.05$) activities respectively. A negative, but not significant relationship, was found between prevention focused leaders and levels of colleague commercialisation engagement within their groups. These findings also lend support to the recommendation of van Berg et al., (2008), that if universities wish to increase their level of commercialisation income, then it is important to have role-models who can create the norms which will lead to increased entrepreneurial behaviour.

Implications for research - theoretical and methodological contributions

This study extends the academic entrepreneurship literature by introducing a multilevel perspective in understanding the local academic context and how the actions of others can either increase or decrease academics' intent to engage in different types of academic entrepreneurship. Prior research in entrepreneurship suggest that studies in entrepreneurial intent should be carried out using multiple levels of analysis (Davidsson & Wiklund, 2001) as

neither individual nor contextual variables on their own adequately explain the nature of entrepreneurial intent. Rather, the interaction between individual and relevant local contextual factors (Roach & Sauermann, 2015) can provide additional insights into what motivates academics to engage in the commercialisation process or why they make certain commercialisation choices.

Furthermore, this article introduces regulatory focus theory into the field of academic entrepreneurship. While the usefulness of regulatory focus theory in explaining various entrepreneurial behaviours in the wider entrepreneurship literature is not new (e.g. Hmieleski & Baron, 2008; Tumasjan & Braun, 2011), empirically testing these theories in order to explore the relationship between the individual academic and local contextual factors and how this enhances or diminishes an academic's intent to commercialise their research is relatively unexplained (Bercovitz & Feldman, 2011; Tartari et al, 2014). The findings also build upon the arguments set out by Tartari et al. (2014) and help explain how academics take account of others when evaluating their commercialisation intentions.

There are a number of contributions to the literature arising from this study. Practically, it contributes to greater understanding of academic entrepreneurship and how actors working in their local social context can moderate, at a cognitive level, academics' commercialisation intentions. At the theoretical level, this study offers a new perspective in the academic entrepreneurship and regulatory focus literature by demonstrating how academic leaders directly (through role modelling effects) and indirectly (through the level of colleague engagement within their group) affect an academic's commercialisation intentions. The findings also confirm that prevention focused individuals are capable of engaging in academic entrepreneurship, and thus it is methodologically important that both promotion and prevention focused scale items should be used in future studies of the field to help bring greater understanding of the motivations, as to why academics behave the way they do.

Finally, this study provides an innovative theoretical and empirical model for how future researchers can study the multilevel interaction between the individual, their leaders and colleagues across a range of contexts.

Implications for practice

The moderating role of regulatory focus on entrepreneurial intent has potential implications for universities in allowing them to achieve their commercialisation objectives. These findings have implications for academic leaders, as the evidence suggests that interactions between a leader's and an individual's regulatory focus can significantly affect commercialisation intentions. As such, universities with an entrepreneurial focus should therefore consider the evaluation criteria for those in leadership roles, so that increased engagement in formal and informal activities are rewarded, which in turn may modify the regulatory focus of their subordinates. Universities focused on academic entrepreneurship should also consider the appointment of leaders who are strong role models and have a track record of success in formal and/or informal commercialisation activities. Such individuals are likely to be viewed as innovation/entrepreneurial champions which would assist in stimulating entrepreneurial behaviour amongst their subordinates. As different leadership behaviours (as viewed through their regulatory focus) are able to elicit differing commercialisation intentions, it may be useful for senior management teams to implement entrepreneurial training courses for leaders. This would enable them to manage the entrepreneurial behaviour of those in their charge, as prior research suggests that entrepreneurship training may be improved by including self-regulatory skill development (e.g. Bryant, 2007; Tumasjan & Braun, 2011). Finally, universities should recognise entrepreneurial colleagues within academic departments and hold them up as commercialisation champions, as this may further strengthen the influence of peer performance on informal and formal commercialisation activities.

Limitations and future research

This research has some limitations that need to be addressed by further research. First, the data set is limited to one country. In order to improve the generality of the findings, studies within other geographical locations are required to validate the findings of our study. Second, two of the measures used in this study are single item measures, and hence, their reliability is difficult to evaluate. It must also be noted that academics who work in research intensive universities and undertake basic research are least likely to respond to surveys related to academic entrepreneurship.

Future research can consider other mediators influencing the academic's local context and commercialisation intentions relationship, to gain a more comprehensive understanding of why academics choose to commercialise their research. For example, institutional and school-specific incentive mechanisms have not been included in the study. Longitudinal research could evaluate the impact of training programs for academic leaders in academic entrepreneurship, looking specifically at effectiveness, or changes in entrepreneurial intent over time. To increase our understanding of entrepreneurial intent throughout universities, future studies might consider the non-STEM academic population. Finally, it would also be helpful to understand if any particular leadership style elicited a situational promotion or prevention focus.

Conclusions

What can a university do to increase the breadth and depth of its research commercialisation and knowledge exchange efforts? Findings from this study confirm that both leaders and academic colleagues play a major role regarding, if and how, an academic engages in commercialisation activities. Recognition of the importance of context in the form of an academic's peer activities is critical in encouraging more entrepreneurial behaviour.

Simply expecting academics to follow their leader isn't enough to motivate them to engage in commercialisation activities.

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Table 1. Correlations and descriptive statistics for study variables																	
Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Dependent variables																	
1 Formal commercialisation intentions	1																
2 Informal commercialisation intentions	0.37***	1															
Control variables																	
3 Gender (male = 1)	0.14***	0.05	1														
4 Age group ($\geq 60 = 5$)	-0.04	0.03	0.22***	1													
5 Employment status (tenured = 1)	-0.05	0.08*	0.15**	0.39***	1												
6 Academic rank (professor = 4)	-0.01	0.09*	0.15**	0.56***	0.55***	1											
7 Research type (applied = 1)	0.17***	0.34***	-0.02	0.05	0.04	-0.04	1										
8 Prior entrepreneurial experience (yes = 1)	0.25***	0.18***	0.15**	0.15***	0.22***	0.12**	0.22***	1									
9 Research intensive university (Russell group =1)	0.04	-0.08	0.02	-0.09*	-0.05	-0.01	-0.17***	-0.12**	1								
10 Management responsibility (yes = 1)	0.13***	0.15***	-0.01	0.25***	0.38***	0.49***	-0.05	0.07	0.06	1							
11 Resources for innovation	0.08*	0.03	0.03	-0.03	-0.14**	-0.03	-0.03	-0.10**	0.05	0.03	1						
Independent variables																	
12 Individual chronic promotion focus	.20***	0.13***	-0.01	-0.19***	-0.11**	-0.10**	-0.02	0.07	-0.01	0.03	0.10***	1					
13 Individual chronic prevention focus	-0.02	-0.09*	-0.06	-0.23***	-0.23***	-0.22***	-0.04	-0.12***	-0.01	-0.08**	-0.03	0.14***	1				
14 Leaders promotion focus	0.10**	0.10***	-0.05	-0.13***	-0.15***	-0.14**	-0.00	0.01	0.01	-0.06	0.15***	0.10**	0.14***	1			
15 Leaders prevention focus	0.04	0.01	0.04	-0.05	-0.03	-0.03	-0.04	-0.00	-0.03	0.02	-0.04	0.06	-0.05	0.01	1		
16 Level of formal colleague engagement	0.30***	0.21***	0.11	0.11**	0.07	0.14***	0.07	0.06	0.06	0.18***	0.11***	0.02	-0.07	0.10**	-0.01	1	
17 Level of informal colleague engagement	0.13**	0.33***	-0.05	0.06	0.02	0.08	0.16***	0.16***	-0.08	0.10**	0.15***	0.04	-0.09*	0.12**	-0.04	0.39***	1
Mean	2.35	3.80	0.72	3.1	0.74	2.58	0.47	0.15	0.38	0.59	3.92	4.79	3.72	4.16	5.06	2.20	2.70
Std. Deviation	1.64	1.51	0.45	1.05	0.44	1.10	0.49	0.35	0.48	0.49	1.08	1.00	1.14	1.13	1.31	0.90	0.96
N = 395 *p <0.05; **p<0.01;***p<0.001																	

Table 2. OLS regression results: Formal Commercialisation Intentions

	Dependent variable 1 – Formal commercialisation intentions							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Control variables								
Gender (Male = 1)	0.16***	0.15***	0.16***	0.15**	.016**	0.09**	0.13**	0.14**
Age	-0.13*	-0.08	-0.08	-0.08	-0.08	-0.13	-0.10	-0.09
Employment status (Tenured = 1)	-0.15*	-0.15*	-0.15*	-0.14*	-0.15*	-0.14*	-0.14**	-0.14*
Academic rank	0.00	-0.01	-0.01	-0.02	-0.01	-0.03	-0.03	0.05
Research type (Applied = 1)	0.14**	0.15**	0.14**	0.14**	0.14**	0.13**	0.14**	0.11*
Prior entrepreneurial experience (Yes = 1)	0.32***	0.28***	0.28***	0.28***	0.28***	0.27***	0.27***	0.27***
Research intensive university	0.06	0.07	0.07	0.06	0.07	0.05	0.05	0.04
Management responsibility (Yes = 1)	0.20***	0.18***	0.18***	0.19***	0.18***	0.15**	0.15**	0.15***
Resources for innovation	0.09*	0.06	0.04	0.04	0.04	0.02	0.01	0.01
Main effects								
Individual regulatory focus								
Individual chronic promotion focus		0.22***	0.21***	0.23***	0.21***	0.20***	0.21***	0.22***
Individual chronic prevention focus		-0.07	-0.08	-0.08	-0.07	-0.06	-0.06	-0.05
Leader regulatory focus								
Leader promotion focus			0.07	0.06	0.07			0.01
Leader prevention focus			-0.01	-0.01	-0.01			-0.01
Interaction effects								
Leader promotion focus x individual chronic promotion focus				0.12*				0.13**
Leader promotion focus x individual chronic prevention focus				0.03				0.04
Leader prevention focus x individual chronic promotion focus					-0.08			-0.09*
Leader prevention focus x individual chronic prevention focus					-0.06			-0.06
Colleague main effects								
Level of formal commercialisation engagement						0.27***	0.27***	0.26***
Level of informal commercialisation engagement						-0.02	-0.02	0.00
Colleague interaction effects								
Level of formal commercialisation engagement x individual chronic promotion focus							0.09*	0.09*
Level of formal commercialisation engagement x individual chronic prevention focus							0.00	-0.01
R2	.203	.245	.249	.265	.259	.306	.314	.341
Delta R2	-	.042	.004	.016	.010	.061	.008	.096
F Statistic	10.905	11.272	9.743	9.126	8.840	12.915	11.589	9.172

*p<0.05; **p<0.01; ***p<0.001

Delta R2 increase: Individual chronic regulatory focus Model 2, Baseline model = Model 1; Leader regulatory focus interactions, Models 4 (Promotion) & 5 (Prevention), Baseline model = Model 3; Colleague engagement interaction, Model 7 baseline model = Model 6

Table 3. OLS regression results: Informal Commercialisation Intentions

	Dependent variable 2 – Informal commercialisation intentions							
	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
Control variables								
Gender (Male = 1)	0.06	0.06	0.06	0.06	0.06	0.08	0.09*	0.09*
Age	-0.12	-0.08	-0.08	-0.08	-0.08	-0.09	-0.08	-0.08
Employment status (Tenured = 1)	-0.02	-0.03	-0.03	-0.02	-0.03	-0.01	-0.02	- 0.01
Academic rank	0.10	0.08	0.09	0.08	0.08	0.06	0.06	0.05
Research type (Applied = 1)	0.40***	0.40***	0.39***	0.39***	0.39***	0.34***	0.34***	0.32***
Prior entrepreneurial experience (Yes = 1)	0.11*	0.07	0.06	0.06	0.06	0.06	0.06	0.06
Research intensive university	-0.04	-0.04	-0.04	-0.04	-0.04	-0.02	-0.02	-0.02
Management responsibility (Yes = 1)	0.18***	0.17***	0.17***	0.17***	0.17**	0.13**	0.13**	0.14**
Resources for innovation	0.05	0.01	-0.01	-0.01	-0.01	-0.05	-0.04	-0.05
Main effects								
Individual regulatory focus								
Individual chronic promotion focus		0.20***	0.20***	0.20***	0.20***	0.18***	0.18***	0.18***
Individual chronic prevention focus		-0.13**	-0.15**	-0.15**	-0.15**	-0.10*	-0.09*	-0.10*
Leader regulatory focus								
Leaders promotion focus			0.11*	0.11*	0.11*			0.07
Leaders prevention focus			-0.03	-0.03	-0.03			-0.02
Interaction effects								
Leaders promotion focus x Individual chronic promotion focus				0.00				0.03
Leaders promotion focus x Individual chronic prevention focus				0.03				0.02
Leaders prevention focus x Individual chronic promotion focus					-0.05			-0.05
Leaders prevention focus x Individual chronic prevention focus					-0.03			-0.02
Colleague main effects								
Level of formal commercialisation engagement						0.06	0.06	0.04
Level of informal commercialisation engagement						0.31***	0.31***	0.31***
Colleague interaction effects								
Level of informal commercialisation engagement x Individual chronic promotion focus							-0.06	-0.06
Level of informal commercialisation engagement x Individual chronic prevention focus							0.15***	0.15***
R2	.230	.272	.284	.284	.287	.375	.394	.403
Delta R2	-	.042	.012	.000	.003	.103	.019	.131
F Statistic	12.769	13.010	11.598	10.040	10.146	17.589	16.456	11.979

*p<0.05;**p<0.01;***p<0.001

Delta R2 increase: Individual chronic regulatory focus Model 10, Baseline model = Model 9; Leader regulatory focus interactions, Models 12 (promotion) & 13 (prevention), Baseline model = Model 11; Colleague engagement level interaction, Model 15, Baseline model = Model 14

Table 4. Summary of hypotheses and results			
No.	Hypothesis	Supported/not supported	R2 increase over baseline model
1a	The stronger an academic's chronic promotion focus, the stronger their intention to engage in formal commercial activities	Supported	.038***
1b	The stronger an academic's chronic prevention focus, the weaker their intention to engage in formal commercial activities	Not supported	(N/S)
2a	The stronger an academic's chronic promotion focus, the stronger their intention to engage in informal commercial activities	Supported	.028***
2b	The stronger an academic's chronic prevention focus, the weaker their intention to engage in informal commercial activities	Supported	.008*
3a	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic regulatory focus and their intention to engage in formal commercial activities	Supported	.016**
3b	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic regulatory focus and their intention to engage in formal commercial activities	Not supported	(N/S)
4a	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic regulatory focus and their intention to engage in informal commercial activities	Not supported	(N/S)
4b	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic regulatory focus and their intention to engage in informal commercial activities	Not supported	(N/S)
5a	The greater the level of colleague engagement in formal commercialisation activities, the more positive the relationship between the individual's chronic promotion focus and their intention to engage in formal commercialisation activities	Supported	.009*
5b	The greater the level of colleague engagement in formal commercialisation activities, the more negative the relationship between the individual's chronic prevention focus and their intention to engage in formal commercialisation activities	Not supported	(N/S)
6a	The greater the level of colleague engagement in informal commercialisation activities, the more positive the relationship between the individual's chronic promotion focus and their intention to engage in informal commercialisation activities	Not supported	(N/S)
6b	The greater the level of colleague engagement in informal commercialisation activities, the more positive the relationship between the individual's chronic prevention focus and their intention to engage in informal commercialisation activities	Supported	.016**
*p<0.05; **p<0.01; ***p<0.001 (N/S) Not significant			

Appendix. Dependent and Independent Variables Scale Items and Sources		
Variable	Items	Reliability
Formal commercialisation intentions	<p>“How likely is it that you will attempt to license technology based on your research in the next 2 years?”</p> <p>“How likely is it that you will attempt to start a company based on your research in the next 2 years?”</p>	CA = .71
Informal commercialisation intentions	<p>“How likely is it that you will engage in contract consultancy in the next 2 years?”</p> <p>“How likely is it that you will engage in continuous professional development in the next 2 years?”</p> <p>“How likely is it that you will engage in contract research in the next 2 years?”</p> <p>“How likely is it that you will engage in collaborative research in the next 2 years?”</p>	CA = .76
Individual chronic regulatory focus. Lockwood, Jordan, and Kunda (2002) - 18 item general regulatory focus scale	<i>Individual Chronic Promotion Focus</i> Example items: “Overall, I am more oriented toward achieving success than preventing failure” “My major goal right now is to achieve my academic ambitions”	CA = .87 VIF = 1.17
	<i>Individual Chronic Prevention Focus</i> Example items: “In general, I am focused on preventing negative events in my life” “My major goal right now is to avoid becoming an academic failure”	CA = .87 VIF = 1.24
	<i>Leader Promotion Focus</i> Items: “My line-manager is good at many different things” “My line-manager sets improvement goals for the department” “My line-manager prefers innovative approaches to traditional approaches”	CA = .71 VIF = 1.16
	<i>Leader Prevention Focus</i> Items: “My line-manager frequently gets on upper management's nerves” (reverse scored) “My line-manager “crosses the line” by doing things that upper management would not formally approve of” (reverse scored) “Not being careful enough has gotten my line-manager into trouble at times” (reverse scored) “My line-manager acts in ways that upper management thinks are objectionable?” (reverse scored)	CA = .91 VIF = 1.05
Level of informal colleague engagement	“Within your work group, colleagues have already participated in any of the following activities; continuous professional development, contract research, contract consultancy or collaborative research”	Single item VIF =1.36
Level of formal colleague engagement	“Within your work group, colleagues have already participated in the formation of a company and/or have licensed technologies in order to commercialise their research”	Single item VIF =1.33
Resources for innovation Scott and Bruce (1994) - 6 item scale	<p>Items:</p> <p>“Assistance in developing new ideas is readily available”</p> <p>“There are adequate resources devoted to innovation in this organisation”</p> <p>“There is adequate time available to pursue creative ideas here”</p> <p>“Lack of funding to investigate creative ideas is a problem in this organisation” (Reverse scored)</p> <p>“Personnel shortages inhibit innovation in this organisation” (Reverse scored)</p> <p>“This organisation gives me free time to pursue creative ideas during the workday”</p>	CA = .79

VIF= Variance inflation factor; CA = Cronbach’s alpha

ⁱ In this article the term “peer” is used to refer to academic colleagues in the same working group and organisational unit at the academic’s university. While peers in the same discipline at other universities or in other disciplines at the same university may have similar effects, they are outside of the scope of this study.

Figure 1: Academic Entrepreneurship Spectrum

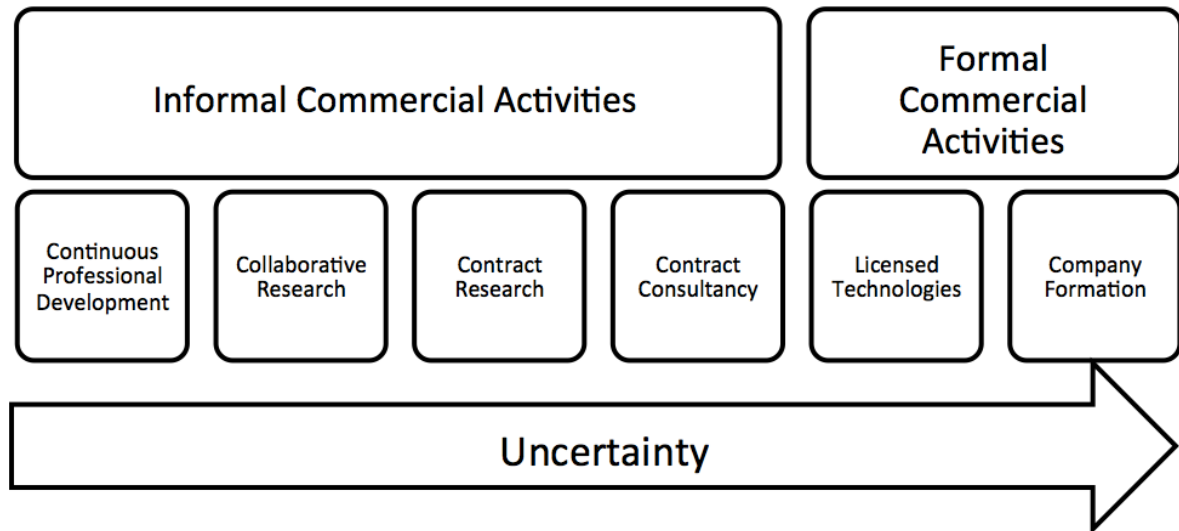


Figure 2: Proposed model of relationships amongst key constructs in the study

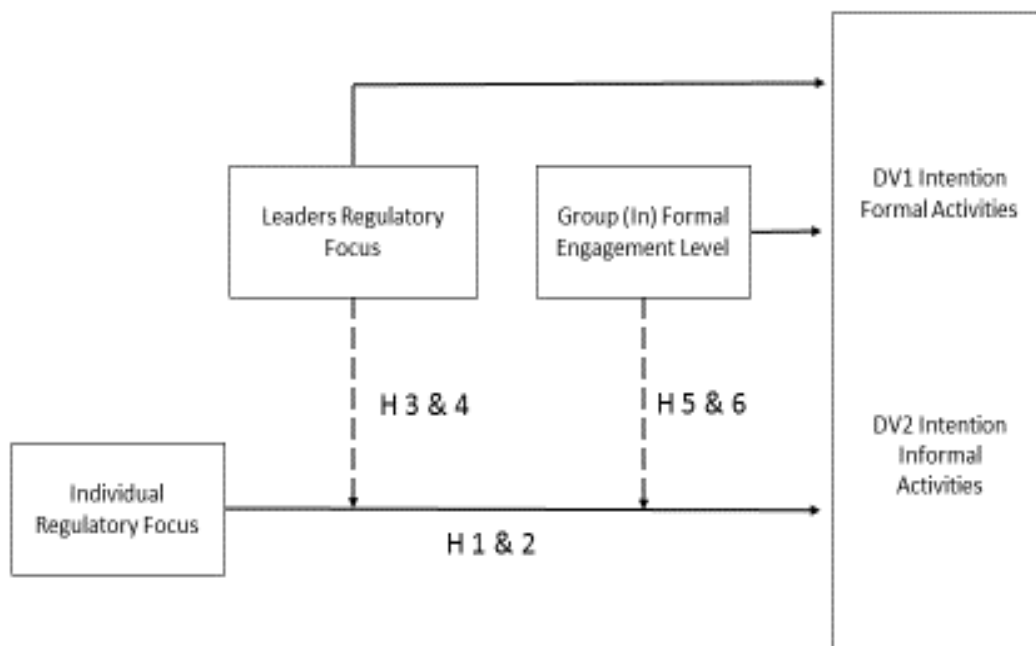


Figure 3: Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Promotion Focus on Formal Commercialisation Intentions

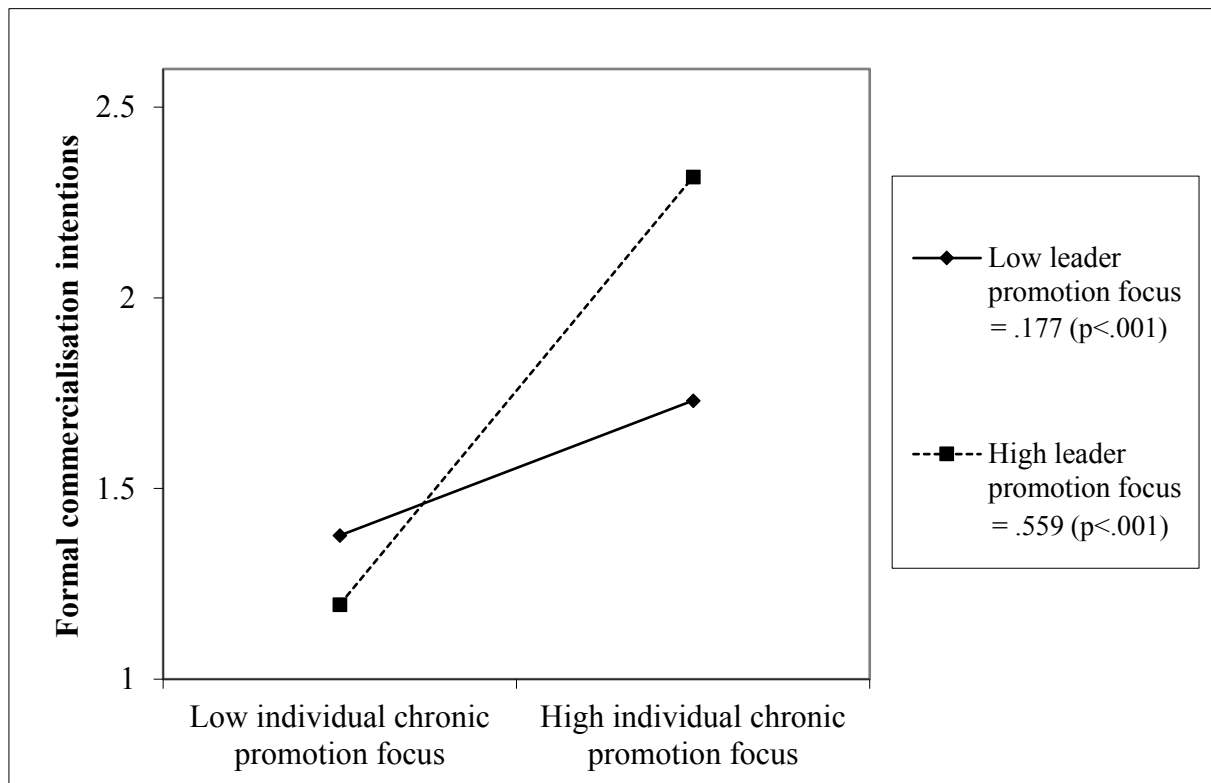


Figure 4: Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Prevention Focus Formal Commercialisation Intentions

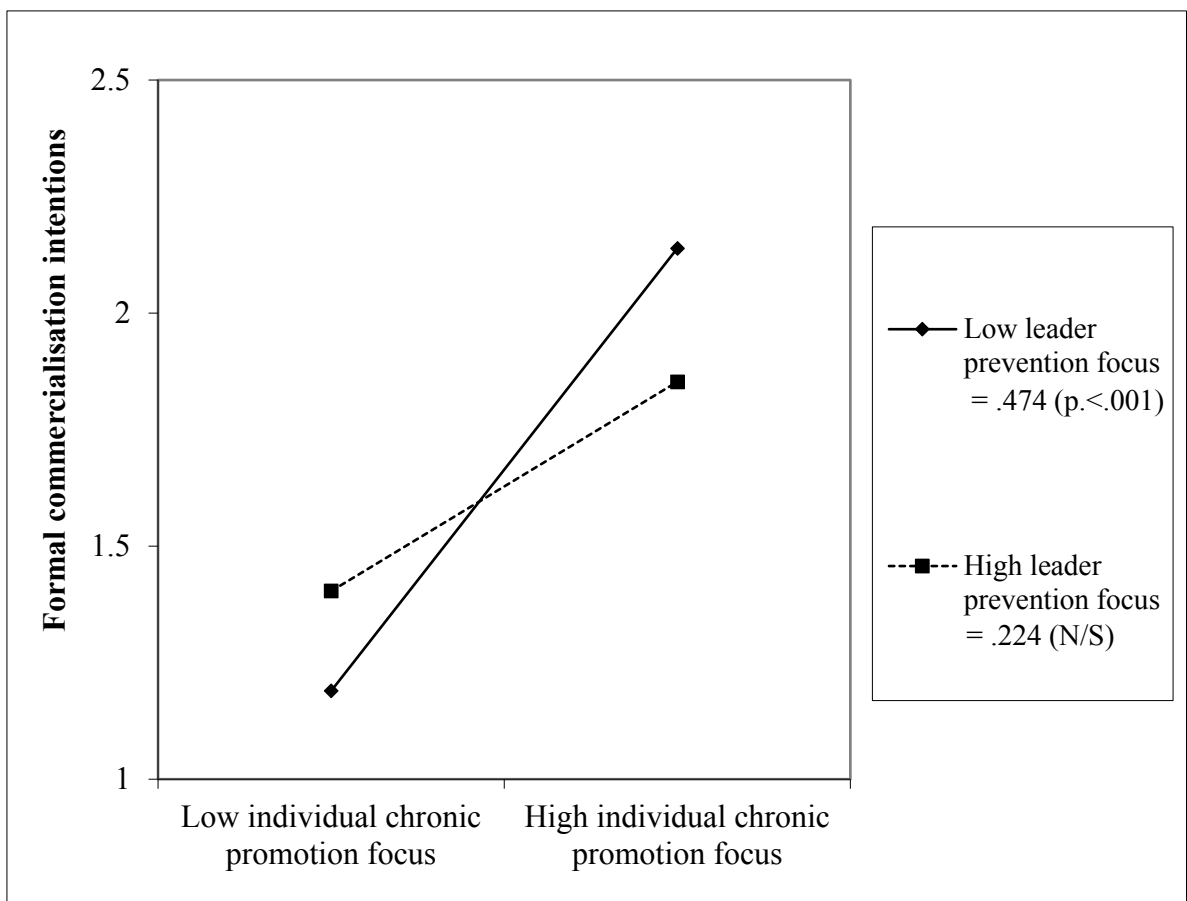


Figure 5: Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Level of Formal Colleague Engagement on Formal Commercialisation Intentions

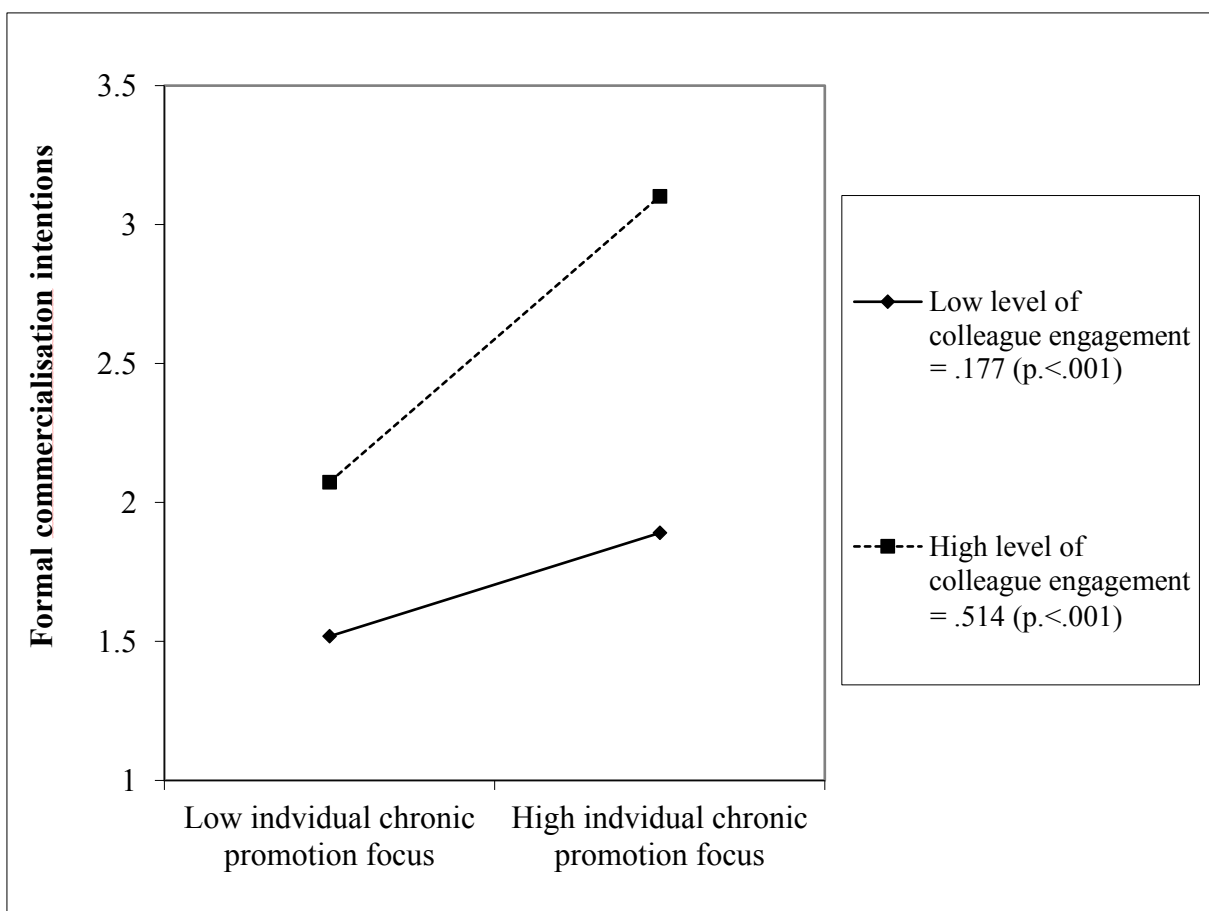


Figure 6: Interaction Diagram Showing the Interaction between Individual Chronic Prevention Focus and Level of Informal Colleague Engagement on Informal Commercialisation Intentions

